What is claimed is:

1. An optical pickup apparatus for reproducing information from an optical information recording medium or for recording information onto an optical information recording medium, comprising:

a first light source for emitting first light flux having a first wavelength;

a second light source for emitting second light flux having a second wavelength, the first wavelength being different from the second wavelength;

a converging optical system having an optical axis and a diffractive portion, and

a photo detector;

wherein in case that the first light flux passes through the diffractive portion to generate at least one diffracted ray, an amount of n-th ordered diffracted ray of the first light flux is greater than that of any other ordered diffracted ray of the first light flux, and in case that the second light flux passes through the diffractive portion to generate at least one diffracted ray, an amount of n-th ordered diffracted ray of the second light flux is greater than that

of any other ordered diffracted ray of the second light flux, where n stands for an integer other than zero.

2. The optical pickup apparatus of claim 1, wherein the optical pickup apparatus reproduces information from at least two kinds of optical information recording media or records information onto at least two kinds of optical information recording media, and

wherein the first light source emits the first light flux for reproducing information from a first optical information recording medium or for recording information onto a first optical information recording medium;

and the second light source emits the second the light flux for reproducing information from a second optical information recording medium or for recording information onto a second optical information recording medium.

3. The optical pickup apparatus of claim 2, wherein the converging optical system is capable of converging the n-th ordered diffracted ray of the first light flux, which is generated at the diffractive portion by the first light flux being reached the diffractive portion, on a first information recording plane of the first optical information

recording medium through a first transparent substrate so as to reproduce information recorded on the first optical information recording medium or to record information onto the first optical information recording medium,
wherein the converging optical system is capable of converging the n-th ordered diffracted ray of the second light flux, which is generated at the diffractive portion by the second light flux being reached the diffractive portion, on a second information recording plane of the second optical information recording medium through a second transparent substrate so as to reproduce information recorded on the second optical information recording medium or to record information onto the second optical information recording medium, and
wherein the photo detector is capable of receiving light flux reflected from the first information recording plane or the second information recording plane.

4. The optical pickup apparatus of claim 3, wherein the converging optical system comprises an objective lens, wherein the converging optical system is capable of converging the n-th ordered diffracted ray of the first light flux on the first information recording plane of the

first optical information recording medium on a condition that a wave-front aberration is not larger than 0.07 λrms when a numerical aperture at an image side of the objective is within a predetermined numerical aperture of the first optical information recording medium, and wherein the converging optical system is capable of converging the n-th ordered diffracted ray of the second light flux on the second information recording plane of the second optical information recording medium on a condition that a wave-front aberration of the second light flux is not larger than 0.07 λrms when a numerical aperture at the image side of the objective is within a predetermined numerical aperture of the second optical information recording medium.

5. The optical pickup apparatus of claim 2, wherein the first optical information recording medium has a first transparent substrate of thickness t1, and
wherein the second optical information recording medium has a second transparent substrate of thickness t2, wherein the thickness t2 is different from the thickness t1.

6. The optical pickup apparatus of claim 5, wherein the converging optical system comprises an objective lens, wherein the converging optical system is capable of converging the n-th ordered diffracted ray of the first light flux on a first information recording plane of the first optical information recording medium on a condition that a wave-front aberration is not larger than 0.07 λrms when a numerical aperture at an image side of the objective is within a predetermined numerical aperture of the first optical information recording medium, and wherein the converging optical system is capable of converging the n-th ordered diffracted ray of the second light flux on a second information recording plane of the second optical information recording medium on a condition that a wave-front aberration is not larger than 0.07 λrms when a numerical aperture at an image side of the objective is within a predetermined numerical aperture of the second optical information recording medium.

7. The optical pickup apparatus of claim 5, wherein the following formula is satisfied:

$\lambda 1 > \lambda 2$ and $t1 < t2$

where $\lambda 1$ is the wave length of the first light flux,

$\lambda 2$ is the wave length of the second light flux,

t1 is the thickness of the first transparent substrate, and

t2 is the thickness of the second transparent substrate.

8. The optical pickup apparatus of claim 7, wherein the following formula is satisfied:

$NA1 > NA2$

Where NA1 is a predetermined numerical aperture of the first optical information recording medium for the first light flux at an image side of the objective lens, and NA2 is a predetermined numerical aperture of the second optical information recording medium for the second light flux at an image side of the objective lens.

9. The optical pickup apparatus of claim 8, wherein the n-th ordered diffracted ray is a positive first ordered diffracted ray.

10. The optical pickup apparatus of claim 8, wherein the following formula is satisfied:

$0.55\ mm < t1 < 0.65\ mm$

$1.1\ mm < t2 < 1.3\ mm$

$630\ nm < \lambda 1 < 670\ nm$

$760\ nm < \lambda 2 < 820\ nm$

$0.55 < NA1 < 0.68$

$0.40 < NA2 < 0.55$

11. The optical pickup apparatus of claim 10, wherein the conversion optical system comprises an objective lens, the objective lens has a diffractive portion, $\lambda 1 = 650$ nm, $t1 = 0.6$ mm, and $NA = 0.6$, and wherein in case that the first light flux which is composed of parallel rays and have a uniform intensity distribution are introduced in the objective lens and are converged on the first information recording plane through the first transparent substrate, a diameter of converged spot is 0.88 μm to 0.91 μm at the best focusing condition.

12. The optical pickup apparatus of claim 10, wherein the conversion optical system comprises an objective lens, the

objective lens has a diffractive portion, $\lambda 1$ = 650 nm, t1 = 0.6 mm, and NA1 = 0.65 and wherein in case that the first light flux which is composed of parallel rays and have a uniform intensity distribution are introduced in the objective lens and are converged on the first information recording plane through the first transparent substrate, a diameter of converged spot is 0.81 µm to 0.84 µm at the best focusing condition.

13. The optical pickup apparatus of claim 10, wherein t1 is 0.6 mm, t2 is 1.2 mm, $\lambda 1$ is 650 nm, $\lambda 2$ is 780 nm, NA1 is 0.6 and NA2 is 0.45.

14. The optical pickup apparatus of claim 8, wherein the conversion optical system comprises an objective lens, and the objective lens has a diffractive portion, and wherein in case that the converging optical system converges the n-th ordered diffracted ray of the second light flux on the second information recording plane of the second optical information recording medium, the spherical aberration comprises at least a discontinuing section by one place.

15. The optical pickup apparatus of claim 14, wherein the spherical aberration comprises the discontinuing section at a place near NA2.

16. The optical pickup apparatus of claim 14, wherein the spherical aberration comprises the discontinuing section at a place at which NA is 0.45.

17. The optical pickup apparatus of claim 14, wherein the spherical aberration comprises the discontinuing section at a place at which NA is 0.5.

18. The optical pickup apparatus of claim 14, wherein the converging optical system converges the n-th ordered diffracted ray having a numerical aperture smaller than NA1 in the first light flux having passed over the diffractive portion on the first information recording plane of the first recording medium such that the wave-front aberration at the best image point is 0.07 λrms and the converging optical system converges the n-th ordered diffracted ray having a numerical aperture smaller than that of the discontinuing section in the second light flux having passed over the diffractive portion on the second information

recording plane of the second recording medium such that the wave-front aberration at the best image point is 0.07 λrms.

19. The optical pickup apparatus of claim 8, wherein the conversion optical system comprises an objective lens, and the objective lens has a diffractive portion, in case that the converging optical system converges the n-th ordered diffracted ray of the second light flux having passed over the diffractive portion on the second information recording plane of the second optical information recording medium in order to conduct the recording or the reproducing for the second optical information recording medium, the spherical aberration is continued without having a discontinuing section.

20. The optical pickup apparatus of claim 19, wherein the spherical aberration at NA1 is not smaller than 20 μm and the spherical aberration at NA2 is not larger than 10 μm.

21. The optical pickup apparatus of claim 5, wherein the following formula is satisfied:

$$\lambda 1 < \lambda 2 \text{ and } t1 > t2$$

where $\lambda 1$ is the wave length (nm) of the first light flux,

$\lambda 2$ is the wave length (nm) of the second light flux,

t1 is the thickness (mm) of the first transparent substrate, and

t2 is the thickness (mm) of the second transparent substrate.

22. The optical pickup apparatus of claim 21, wherein the n-th ordered diffracted ray is a negative first ordered diffracted ray.

23. The optical pickup apparatus of claim 1, wherein a diffracting efficiency at the diffractive portion for the n-th ordered diffracted ray of the first light flux is A% and a diffracting efficiency for another ordered diffracted ray of the first light flux is B%, the diffracting efficiencies satisfy the following formula: $A - B \geq 10$, and a diffracting efficiency at the diffractive portion for the n-th ordered diffracted ray of the second light flux is A'% and a diffracting efficiency for another ordered diffracted ray of the first light flux is B'%, the diffracting efficiencies satisfy the following formula: $A' - B' \geq 10$.

24. The optical pickup apparatus of claim 1, wherein a diffracting efficiency at the diffractive portion for the n-th ordered diffracted ray of the first light flux is A% and a diffracting efficiency for another ordered diffracted ray of the first light flux is B%, the diffracting efficiencies satisfy the following formula: $A - B \geq 50$, and a diffracting efficiency at the diffractive portion for the n-th ordered diffracted ray of the second light flux is A'% and a diffracting efficiency for another ordered diffracted ray of the first light flux is B'%, the diffracting efficiencies satisfy the following formula: $A' - B' \geq 50$.

25. The optical pickup apparatus of claim 1, wherein a difference in wavelength between the first light flux and the second light flux is 80 nm to 400 nm.

26. The optical pickup apparatus of claim 1, wherein

the diffractive portion comprises a plurality of annular bands formed coaxially around the optical axis or around a point near the optical axis as a center.

27. The optical pickup apparatus of claim 26, wherein a phase difference function expressed by power series indicating each position of the plurality of annular bands has a coefficient except zero in at least one term except 2nd power term.

28. The optical pickup apparatus of claim 26, wherein a phase difference function expressed by power series indicating each position of the plurality of annular bands has a coefficient except zero in 2nd power term.

29. The optical pickup apparatus of claim 26, wherein a phase difference function expressed by power series indicating each position of the plurality of annular bands has not 2nd power term.

30. The optical pickup apparatus of claim 26, wherein a sign of negative or positive of a diffracting effect added by the diffractive portion is switched at least one time in a direction departing from the optical axis perpendicularly to the optical axis.

31. The optical pickup apparatus of claim 30, wherein the plurality of annular bands in the diffractive portion are blazed, a stepped section in an annular band located at a side close to the optical axis is located at a side distant from the optical axis, and a stepped section in an annular band located at a side distant from the optical axis is located at a side close to the optical axis.

32. The optical pickup apparatus of claim 30, wherein the plurality of annular bands in the diffractive portion are blazed, a stepped section in an annular band located at a side close to the optical axis is located at a side close to the optical axis, and a stepped section in an annular band located at a side distant from the optical axis is located at a side distant from the optical axis.

33. The optical pickup apparatus of claim 26, wherein the converging optical system comprises an objective lens, a pitch Pf of the annular bands in the diffractive portion corresponding to a maximum numerical aperture at the image side of the objective lens and a pitch Ph of the annular bands in the diffractive portion corresponding to half of

the maximum numerical aperture satisfy the following formula.

$$0.4 \leq |(Ph/Pf) - 2| \leq 25$$

34. The optical pickup apparatus of claim 26, wherein the diffractive portion comprises a first diffractive pattern and a second diffractive pattern and the second diffractive pattern is located distant from the optical axis more than the first diffractive pattern.

35. The optical pickup apparatus of claim 34, wherein the amount of n-th ordered diffracted ray is generated more than that of other ordered diffracted ray in the first light flux having passed over the first diffractive pattern of the diffractive portion, the amount of the n-th ordered diffracted ray is generated more than that of other ordered diffracted ray in the second light flux having passed over the first diffractive pattern of the diffractive portion, an amount of the n-th ordered diffracted ray is generated more than that of other ordered diffracted ray in the first light flux having passed over the second diffractive pattern of the diffractive portion, and an amount of 0th ordered diffracted ray is generated more than that of other ordered

diffracted ray in the second light flux having passed over the second diffractive pattern of the diffractive portion.

36. The optical pickup apparatus of claim 34, wherein an amount of n-th ordered diffracted ray is generated more than that of other ordered diffracted ray in the first light flux having passed over the first diffractive pattern of the diffractive portion, an amount of the 0th ordered diffracted ray is generated more than that of other ordered diffracted ray in the second light flux having passed over the first diffractive pattern of the diffractive portion, an amount of the n-th ordered diffracted ray is generated more than that of other ordered diffracted ray in the first light flux having passed over the second diffractive pattern of the diffractive portion, and an amount of negative ordered diffracted ray except the n-th order is generated more than that of other ordered diffracted ray in the second light flux having passed over the second diffractive pattern of the diffractive portion.

37. The optical pickup apparatus of claim 26, wherein the converging optical system comprises an objective lens, all light flux within the maximum numerical aperture at an image

side of the objective lens, passes through the diffractive portion.

38. The optical pickup apparatus of claim 26, wherein the converging optical system comprises an objective lens, a part of light flux within the maximum numerical aperture at an image side of the objective lens, passes through the diffractive portion and another part of light flux within the maximum numerioal aperture does not pass through the diffractive portion.

39. The optical pickup apparatus of claim 26, wherein a number of steps on the annular bands in the diffractive portion is 2 to 45.

40. The optical pickup apparatus of claim 39, wherein a number of steps on the annular bands in the diffractive portion is 2 to 15.

41. The optical pickup apparatus of claim 26, wherein a depth, in the optical axial direction, of a stepped section on the annular bands in the diffractive portion is not larger than 2 μm.

42. The optical pickup apparatus of claim 26, wherein the optical converging system comprises an objective lens and the diffractive portion is provided on the objective lens, the pitch of the diffractive portion at a point at which NA = 0.4 is 10 μm to 70 μm.

43. The optical pickup apparatus of claim 1, wherein the converging optical system comprises a lens having a refracting surface and wherein the diffractive portion is provided on the lens.

44. The optical pickup apparatus of claim 43, wherein the lens provided with the diffractive portion is an objective lens.

45. The optical pickup apparatus of claim 44, wherein the objective lens provided with the diffractive portion comprises a flange section on a outer circumference thereof.

46. The optical pickup apparatus of claim 44, wherein the refracting surface of the objective lens provided with the diffractive portion is an aspherical surface.

47. The optical pickup apparatus of claim 43, wherein the lens provided with the diffractive portion is made of a material whose Abbe's number νd is not smaller than 50.

48. The optical pickup apparatus of claim 43, wherein the lens provided with the diffractive portion is a plastic lens.

49. The optical pickup apparatus of claim 43, wherein the lens provided with the diffractive portion is a glass lens.

50. The optical pickup apparatus of claim 1, wherein the n-th ordered diffracted ray is a positive first ordered diffracted ray or a negative first ordered diffracted ray.

51. The optical pickup apparatus of claim 1, wherein a diffracting efficiency of the n-th ordered diffracted ray by the diffractive portion becomes maximum in a wavelength between the wavelength of the first light flux and the wavelength of the second light flux.

52. The optical pickup apparatus of claim 1, wherein a diffracting efficiency of the n-th ordered diffracted ray by the diffractive portion becomes maximum in the wavelength of the first light flux or in the wavelength of the second light flux.

53. The optical pickup apparatus of claim 1, wherein the converging optical system comprises an objective lens, the wavelength of the second light flux is longer than the wavelength of the first light flux, and an axial chromatic aberration Z satisfies the following formula:

$$-\lambda_2 / (2NA_2^2) \leq Z \leq \lambda_2 / (2NA_2^2)$$

where λ_2 is the wavelength of the second light flux, and

NA_2 is a predetermined numerical aperture at an image side of the objective lens of the second optical infornation recording medium for the second light flux.

54. The optical pickup apparatus of claim 1, further comprising:

a third light source for emitting third light flux having a third wavelength, wherein the third wavelength is

different from the first wavelength and the second wavelength.

55. The optical pickup apparatus of claim 54, wherein an amount of n-th ordered diffracted ray is generated greater than that of other ordered of diffracted ray in the third light flux having passed over the diffractive portion.

56. The optical pickup apparatus of claim 1, wherein the converging optical system comprises an objective lens, and at least one of an aperture limiting means to shade or diffract the first light flux positioned outside of the predetermined numerical aperture of the second optical information recording medium at the image side of the objective lens and to allow the second light flux to pass through and an aperture limiting means to shade or diffract the second light flux positioned outside of the predetermined numerical aperture of the first optical information recording medium at the image side of the objective lens and to allow the first light flux to pass through.

57. The optical pickup apparatus of claim 1, wherein the converging optical system comprises an objective lens, and

dose not comprise an aperture limiting means to shade or diffract the first light flux positioned outside of the predetermined numerical aperture of the second optical information recording medium at the image side of the objective lens and to allow the second light flux to pass through and an aperture of the first optical information recording medium limiting means to shade or diffract the second light flux positioned outside of the predetermined numerical aperture at the image side of the objective lens and to allow the first light flux to pass through.

58. The optical pickup apparatus of claim 1, wherein the converging optical system comprises a lens having a refracting surface and wherein the diffractive portion is provided on the lens and the following formula is satisfied:

$$- 0.0002/^{\circ}C < \Delta n/\Delta T < - 0.00005\ ^{\circ}C$$

$$0.05\ nm/^{\circ}C < \Delta\lambda_1/\Delta T < 0.5\ nm/^{\circ}C$$

wherein ΔT is a temperature change, and

Δn is a change in refractive index of the lens.

$\Delta\lambda_1$ is a change in wavelength of the first light source at the time that the temperature change ΔT takes place.

59. The optical pickup apparatus of claim 1, wherein the converging optical system comprises an objective lens and the following formula is satisfied:

$$0.2 \times 10^{-6}/^{\circ}C < \Delta WSA3 \cdot \lambda 1/\{f \cdot (NA1)^4 \cdot \Delta T\} < 2.2 \times 10^{-6}/^{\circ}C$$

where NA1 is the numerical aperture of the first optical information recoding medium for the first light flux at an image side of the objective lens,

$\lambda 1$ is the wavelength of the first light flux,

ΔT is an ambient temperature change; and

$\Delta WSA3$ is a changed amount of a third order spherical aberration component of a wave-front aberration of a light flux converged onto an optical information recording plane in the case of reproducing information from or recording information on the optical information recording medium by using the first light flux.

60. The optical pickup apparatus of claim 1,

wherein the converging optical system comprises an objective lens,

wherein in case that the first light flux is used, the first light flux positioned inside a predetermined numerical

aperture of a first optical information recording medium at an image side of the objective lens is converged onto a first information recording plane of a first optical information recording medium on a condition that a wave-front aberration is not larger than 0.07 λrms,

wherein a wave-front aberration of the first light flux passing outside the predetermined numerical aperture is larger than 0.07 λrms on the first information recording plane, and

wherein in case that the second light flux is used, the second light flux passing inside the predetermined numerical aperture and the second light flux passing outside the predetermined numerical aperture are converged on a second information recording plane of a second optical information recording medium on a condition that a wave-front aberration is not larger than 0.07 λrms, or

wherein in case that the second light flux is used, the second light flux positioned inside a predetermined numerical aperture of a second optical information recording medium at an image side of the objective lens is converged onto a first information recording plane of a second optical information

recording medium on a condition that a wave-front aberration is not larger than 0.07 λrms,

wherein a wave-front aberration of the second light flux passing outside the predetermined numerical aperture is larger than 0.07 λrms on the second information recording plane, and

wherein in case that the first light flux is used, the first light flux passing inside the predetermined numerical aperture and the first light flux passing outside the predetermined numerical aperture are converged on a first information recording plane on a condition that a wave-front aberration is not larger than 0.07 λrms.

61. The optical pickup apparatus of claim 1,

wherein the converging optical system comprises an objective lens,

wherein in case that the first light flux is used, the first light flux positioned inside a predetermined numerical aperture of the first optical information recording medium at an image side of the objective lens is converged onto a first information recording plane of a first optical information

recording medium on a condition that a wave-front aberration is not larger than 0.07 λrms,

wherein the first light flux passing outside the predetermined numerical aperture is converged onto the first information recording plane on a condition that a wave-front aberration is not larger than 0.07 λrms or shaded so as not to reach to the first information recording plane, and

wherein in case that the second light flux is used, the second light flux passing inside the predetermined numerical aperture and the second light flux passing outside the predetermined numerical aperture are converged onto a second information recording plane of a second optical information recording medium on a condition that a wave-front aberration is not larger than 0.07 λrms, or

wherein in case that the second light flux is used, the second light flux positioned inside a predetermined numerical aperture of the second optical information recording medium at an image side of the objective lens is converged onto a second information recording plane of a second optical information recording medium on a condition that a wave-front aberration is not larger than 0.07 λrms,

wherein, the second light flux passing outside the predetermined numerical aperture is converged onto the second information recording plane on a condition that a wave-front aberration is not larger than 0.07 λrms or shaded so as not to reach to the second information recording plane, and

wherein in case that the first light flux is used, the first light flux passing inside the predetermined numerical aperture and the first light flux passing outside the predetermined numerical aperture are converged onto a first information recording plane of a first optical information recording medium on a condition that a wave-front aberration is not larger than 0.07 λrms.

62. The optical pickup apparatus of claim 1, wherein the converging optical system comprises a objective lens, and wherein the first light flux of non-parallel light flux is allowed to go into the objective lens when the first light flux is used, and the second light flux of non-parallel light flux is allowed to go into the objective lens when the second light flux is used.

63. The optical pickup apparatus of claim 62, wherein the non-parallel light flux is divergent light.

64. The optical pickup apparatus of claim 62, wherein the non-parallel light flux is convergent light.

65. The optical pickup apparatus of claim 1, wherein the converging optical system comprises a objective lens, and wherein the first light flux of parallel light flux is allowed to go into the objective lens when the first light flux is used and the second light flux of non-parallel light flux is allowed to go into the objective lens when the second light flux is used, or the first light flux of non-parallel light flux is allowed to go into the objective lens when the first light flux is used and the second light flux of parallel light flux is allowed to go into the objective lens when the second light flux is used.

66. The optical pickup apparatus of claim 65, wherein the non-parallel light flux is divergent light.

67. The optical pickup apparatus of claim 65, wherein the non-parallel light flux is convergent light.

68. The optical pickup apparatus of claim 1, wherein , and wherein the first light flux of parallel light flux is allowed to go into the objective lens when the first light flux is used and the second light flux of parallel light flux is allowed to go into the objective lens when the second light flux is used.

69. The optical pickup apparatus of claim 1, wherein the converging optical system comprises an objective lens and divergent degree changing means for changing a degree of divergent of light flux coming into the objective lens.

70. The optical pickup apparatus of claim 1, wherein the photo detector is common to the first light flux and the second light flux.

71. The optical pickup apparatus of claim 1, further comprising a second photo detector, wherein the photo detector is used for the first light flux and the second photo detector is used for the second light flux.

72. The optical pickup apparatus of claim 1, wherein the photo detector and one of the first light source and the second light source are made in a unit.

73. The optical pickup apparatus of claim 1, wherein the photo detector, the first light source and the second light source are made in a unit.

74. The optical pickup apparatus of claim 1, further comprising a second photo detector, wherein the photo detector is used for the first light flux, the second photo detector is used for the second light flux, and the photo detector, the second image sensor, the first light source and the second light source are made in a unit.

75. The optical pickup apparatus of claim 1, wherein the first light source and the second light source are made in a unit.

76. The optical pickup apparatus of claim 1, wherein over shoot is 0% to 20%.

77. An optical element for use in an optical pickup apparatus for reproducing information from an optical information recording medium or for recoding information onto an optical information recording medium, comprising:

an optical axis, and

a diffractive portion,

wherein in case that the first light flux passes through the diffractive portion to generate at least one diffracted ray, an amount of n-th ordered diffracted ray of the first light flux is greater than that of any other ordered diffracted ray of the first light flux, and in case that the second light flux whose wavelength is different from that of the first light flux passes through the diffractive portion to generate at least one diffracted ray, an amount of n-th ordered diffracted ray of the second light flux is greater than that of any other ordered diffracted ray of the second light flux,

wherein a difference in wavelength between the first light flux and the second light flux is 80 nm to 400 nm and n stands for an integer other than zero.

78. The optical element of claim 77, wherein the optical pickup apparatus comprises a first light source for emitting first light flux having a first wavelength, a second light

source for emitting second light flux having second wavelength, and an image sensor.

79. The optical element of claim 77, wherein the optical pickup apparatus reproduces information from at least two kinds of optical information recording media or records information onto one of the different kinds of optical information recording media, and
wherein the first light source emits the first light flux for reproducing information from a first optical information recording medium or for recording information onto a first optical information recording medium;
and the second light source emits the second light flux for reproducing information from a second optical information recording medium or for recording information onto a second optical information recording medium.

80. The optical element of claim 79, wherein the optical element is capable of converging the n-th ordered diffracted ray of the first light flux, which is generated at the diffractive portion by the first light flux being reached the diffractive portion, on a first information recording plane of the first optical information recording medium

through a first transparent substrate so as to reproduce information recorded on the first optical information recording medium or to record information onto the first optical information recording medium, and

wherein the optical element is capable of converging the n-th ordered diffracted ray of the second light flux, which is generated at the diffractive portion by the second light flux being reached the diffractive portion on a second information recording plane of the second optical information recording medium through a second transparent substrate so as to reproduce information recorded in the second optical information to record medium or recording information onto the second optical information recording medium.

81. The optical element of claim 80, wherein the optical pickup apparatus comprises an objective lens,

wherein the converging optical system is capable of converging the n-th ordered diffracted ray of the first light flux on the first information recording plane of the first optical information recording medium on a condition that a wave-front aberration is not larger than 0.07 λrms when a numerical aperture at an image side of the objective

is within a predetermined numerical aperture of the first optical information recording medium, and wherein the converging optical system is capable of converging the n-th ordered diffracted ray of the second light flux on a second information recording plane of the second optical information recording medium on a condition that a wave-front aberration is not larger than 0.07 λrms when a numerical aperture at the image side of the objective is within a predetermined numerical aperture of the second optical information recordng medium.

82. The optical element of claim 79, wherein the first optical information recording medium has a first transparent substrate of thickness t1, and
wherein the second optical information recording medium has a second transparent substrate of thickness t2, wherein the thickness t2 is different from the thickness t1.

83. The optical element of claim 82, wherein the optical pickup apparatus comprises an objective lens,
wherein the converging optical system is capable of converging the n-th ordered diffracted ray of the first light flux on the first information recording plane of the

first optical information recording medium on a condition that a wave-front aberration is not larger than 0.07 λrms when a numerical aperture at the image side of the objective is within a predetermined numerical aperture of the first optical information recording medium, and wherein the converging optical system is capable of converging the n-th ordered diffracted ray of the second light flux onto a second information recording plane of the second optical information recording medium on a condition that a wave-front aberration is not larger than 0.07 λrms when a numerical aperture at the image side of the objective is within a predetermined numerical aperture of the second optical recording medium.

84. The optical element of claim 82, wherein the following formula is satisfied:

$\lambda 1 < \lambda 2$ and $t1 < t2$

where $\lambda 1$ is the wave length of the first light flux,

$\lambda 2$ is the wave length of the second light flux,

$t1$ is the thickness of the first transparent substrate, and

t2 is the thickness of the second transparent substrate.

85. The optical element of claim 84, wherein the following formula is satisfied:

$$NA1 > NA2$$

Where NA1 is a predetermined numerical aperture of the first optical information recording medium for the first light flux at an image side of the objective lens, and NA2 is a predetermined numerical aperture the second optical information recording medium for the second light flux at an image side of the objective lens.

86. The optical element of claim 85, wherein the n-th ordered diffracted ray is a positive first ordered diffracted ray.

87. The optical element of claim 85, wherein the following formula is satisfied:

$$0.55 \text{ mm} < t1 < 0.65 \text{ mm}$$

$$1.1 \text{ mm} < t2 < 1.3 \text{ mm}$$

$$630 \text{ nm} < \lambda 1 < 670 \text{ nm}$$

$760\ \text{nm} < \lambda 2 < 820\ \text{nm}$

$0.55 < NA1 < 0.68$

$0.40 < NA2 < 0.55$

88. The optical element of claim 87, wherein the optical element is an objective lens, $\lambda 1 = 650$ nm, $t1 = 0.6$ mm, and $NA1 = 0.6$ and wherein in case that the first light flux which is composed of parallel rays and have a uniform intensity distribution are introduced in the objective lens and are converged on the first information recording plane through the first transparent substrate, a diameter of converged spot is 0.88 µm to 0.91 µm at the best focusing condition.

89. The optical element of claim 87, wherein the optical element is an objective lens, $\lambda 1 = 650$ nm, $t1 = 0.6$ mm, and $NA = 0.65$ and wherein in case that the first light flux which is composed of parallel rays and have a uniform intensity distribution are introduced in the objective lens and are converged on the first information recording plane through the first transparent substrate, a diameter of converged spot is 0.81 µm to 0.84 µm at the best focusing condition.

90. The optical element of claim 87, wherein t1 is 0.6 mm, t2 is 1.2 mm, $\lambda 1$ is 650 nm, $\lambda 2$ is 780 nm, NA1 is 0.6 and NA2 is 0.45.

91. The optical element of claim 85, wherein the optical element is an objective lens, and in case that the objective lens converges the n-th ordered diffracted ray of the second light flux on the second information recording plane of the second optical information recording medium, the spherical aberration comprises a discontinuing section in at least one place.

92. The optical element of claim 91, wherein the spherical aberration comprises the discontinuing section at a place near NA2.

93. The optical element of claim 91, wherein the spherical aberration comprises the discontinuing section at a place at which NA is 0.45.

94. The optical element of claim 91, wherein the spherical aberration comprises the discontinuing section at a place at which NA is 0.5.

95. The optical element of claim 91, wherein the objective lens converges the n-th ordered diffracted ray having a numerical aperture smaller than NA1 in the first light flux having passed over the diffractive portion on the first information recording plane of the first recording medium such that the wave-front aberration at the best image point is 0.07 λrms and the objective lens converges the n-th ordered diffracted ray having a numerical aperture smaller than that of the discontinuing section in the second light flux having passed over the diffractive portion on the second information recording plane of the second recording medium such that the wave-front aberration at the best image point is 0.07 λrms.

96. The optical element of claim 85, wherein the optical element is an objective lens, and in case that the converging optical system converges the n-th ordered diffracted ray in the second light flux having passed over the diffractive portion on the second information recording plane of the

second optical information recording medium in order to conduct the recording or the reproducing for the second optical information recording medium, the spherical aberration is continued without having a discontinuing section.

97. The optical element of claim 96, wherein the spherical aberration at NA1 is not smaller than 20 μm and the spherical aberration at NA2 is not larger than 10 μm.

98. The optical element of claim 82, wherein the following formula is satisfied:

$$\lambda 1 < \lambda 2 \quad \text{and} \quad t1 > t2$$

where $\lambda 1$ is the wave length of the first light flux,

$\lambda 2$ is the wave length of the second light flux,

t1 is the thickness of the first transparent substrate, and

t2 is the thickness of the second transparent substrate.

99. The optical element of claim 98, wherein the n-th ordered diffracted ray is a negative first ordered diffracted ray.

100. The optical element of claim 77, wherein a diffracting efficiency at the diffractive portion for the n-th ordered diffracted ray of the first light flux is A% and a diffracting efficiency for another ordered diffracted ray of the first light flux is B%, the diffracting efficiencies satisfy the following formula: $A - B \geq 10$, and a diffracting efficiency at the diffractive portion for the n-th ordered diffracted ray of the second light flux is A'% and a diffracting efficiency for another ordered diffracted ray of the second light flux is B'%, the diffracting efficiencies satisfy the following formula: $A' - B' \geq 10$.

101. The optical element of claim 100, wherein a diffracting efficiency at the diffractive portion for the n-th ordered diffracted ray of the first light flux is A% and a diffracting efficiency for another ordered diffracted ray of the first light flux is B%, the diffracting efficiencies satisfy the following formula: $A - B \geq 50$, and a diffracting efficiency at the diffractive portion for the n-th ordered

diffracted ray of the second light flux is A'% and a diffracting efficiency for another ordered diffracted ray of the second light flux is B'%, the diffracting efficiencies satisfy the following formula: $A' - B' \geq 50$.

102. The optical element of claim 77, wherein the diffractive portion comprises a plurality of annular bands formed coaxially around the optical axis or around a point near the optical axis as a center.

103. The optical element of claim 102, wherein a phase difference function expressed by power series indicating each position of the plurality of annular bands has a coefficient except zero in at least one term except 2nd power term.

104. The optical element of claim 102, wherein a phase difference function expressed by power series indicating each position of the plurality of annular bands has a coefficient except zero in 2nd power term.

105. The optical element of claim 102, wherein a phase difference function expressed by power series indicating each

position of the plurality of annular bands has not 2nd power term.

106. The optical element of claim 102, wherein a sign of negative or positive of a diffracting effect added by the diffractive portion is switched at least one time in a direction departing from the optical axis perpendicularly to the optical axis.

107. The optical element of claim 106, wherein the plurality of annular bands in the diffractive portion are blazed, a stepped section in an annular band located at a side close to the optical axis is located at a side distant from the optical axis, and a stepped section in an annular band located at a side distant from the optical axis is located at a side close to the optical axis.

108. The optical element of claim 106, wherein the plurality of annular bands in the diffractive portion are blazed, a stepped section in an annular band located at a side close to the optical axis is located at a side close to the optical axis, and a stepped section in an annular band

located at a side distant from the optical axis is located at a side distant from the optical axis.

109. The optical element of claim 102, wherein the pickup apparatus comprises an objective lens, a pitch Pf of the annular bands in the diffractive portion corresponding to a maximum numerical aperture at the image side of the objective lens and a pitch Ph of the annular bands in the diffractive portion corresponding to half of the maximum numerical aperture satisfy the following formula.

$$0.4 \leq |(Ph/Pf) - 2| \leq 25$$

110. The optical element of claim 102, wherein the diffractive portion comprises a first diffractive pattern and a second diffractive pattern and the second diffractive pattern is located distant from the optical axis more than the first diffractive pattern.

111. The optical element of claim 110, wherein the amount of n-th ordered diffracted ray is generated more than that of other ordered diffracted ray in the first light flux having passed over the first diffractive pattern of the diffractive portion, the amount of the n-th ordered

diffracted ray is generated more than that of other ordered diffracted ray in the second light flux having passed over the first diffractive pattern of the diffractive portion, an amount of the n-th ordered diffracted ray is generated more than that of other ordered diffracted ray in the first light flux having passed over the second diffractive pattern of the diffractive portion, and an amount of 0-th ordered diffracted ray is generated more than that of other ordered diffracted ray in the second light flux having passed over the second diffractive pattern of the diffractive portion.

112. The optical element of claim 110, wherein an amount of n-th ordered diffracted ray is generated more than that of other ordered diffracted ray in the first light flux having passed over the first diffractive pattern of the diffractive portion, an amount of the n-th ordered diffracted ray is generated more than that of other ordered diffracted ray in the second light flux having passed over the first diffractive pattern of the diffractive portion, an amount of the 0-th ordered diffracted ray is generated more than that of other ordered diffracted ray in the first light flux having passed over the second diffractive pattern of the diffractive portion, and an amount of negative ordered

diffracted ray except the n-th order is generated more than that of other ordered diffracted ray in the second light flux having passed over the second diffractive pattern of the diffractive portion.

113. The optical element of claim 102, wherein the diffractive portion is provided on the substantially entire surface of a light flux-incoming surface or a light flux-outgoing surface of the optical element.

114. The optical element of claim 102, wherein an area of the diffractive portion is 10% to 90% of an area of a light flux-incoming surface or a light flux-outgoing surface of the optical element.

115. The optical element of claim 102, wherein a number of steps on the annular bands in the diffractive portion is 2 to 45.

116. The optical element of claim 115, wherein a number of steps on the annular bands in the diffractive portion is 2 to 15.

117. The optical element of claim 102, wherein a depth, in the optical axial direction, of a stepped section on the annular bands in the diffractive portion is not larger than 2 μm.

118. The optical element of claim 102, wherein the pitch of the diffractive portion at a point at which NA = 0.4 is 10 μm to 70 μm.

119. The optical element of claim 77, wherein the optical element is a lens having a refracting surface.

120. The optical element of claim 119, wherein the optical element is an objective lens.

121. The optical element of claim 119, wherein the optical element is a collimator lens.

122. The optical element of claim 77, wherein the optical element is not an objective lens and a collimator lens.

123. The optical element of claim 120, wherein the objective lens comprises a flange section on a outer circumference thereof.

124. The optical element of claim 120, wherein the refracting surface of the objective lens is an aspherical surface.

125. The optical element of claim 119, wherein the lens is made of a material whose Abbe number νd is not smaller than 50.

126. The optical element of claim 119, wherein the lens is a plastic lens.

127. The optical element of claim 119, wherein the lens is a glass lens.

128. The optical element of claim 77, wherein the n-th ordered diffracted ray is a positive first ordered diffracted ray or a negative first ordered diffracted ray.

129. The optical element of claim 77, wherein a diffracting efficiency of the n-th ordered diffracted ray by the diffractive portion becomes maximum in a wavelength between the wavelength of the first light flux and the wavelength of the second light flux.

130. The optical element of claim 77, wherein a diffracting efficiency of the n-th ordered diffracted ray by the diffractive portion becomes maximum in the wavelength of the first light flux or in the wavelength of the second light flux.

131. The optical element of claim 77, wherein the optical element satisfies the following formula:

$$- 0.0002/^{\circ}C < \Delta n/\Delta T < - 0.00005\ ^{\circ}C$$

wherein ΔT is a temperature change, and

Δn is a change in refractive index of the lens.

132. The optical element of claim 77, wherein the optical pickup apparatus comprises an objective lens,

wherein in case that the first light flux is used, the first light flux positioned inside a predetermined numerical aperture of a first optical information recording medium at

the image side of the objective lens is converged onto a first information recording plane of a first optical information recording medium on a condition that a wave-front aberration is not larger than 0.07 λrms,

wherein a wave-front aberration of the first light flux passing outside the predetermined numerical aperture is larger than 0.07 λrms on the first information recording plane, and

wherein in case that the second light flux is used, the second light flux passing inside the predetermined numerical aperture and the second light flux passing outside the predetermined numerical aperture are converged on a second information recording plane of a second optical information recording medium on a condition that a wave-front aberration is not larger than 0.07 λrms, or

wherein in case that the second light flux is used, the second light flux positioned inside a predetermined numerical aperture of a second optical information recording medium at the image side of the objective lens is converged onto a first information recording plane of a second optical information recording medium on a condition that a wave-front aberration is not larger than 0.07 λrms, wherein a wave-

front aberration of the second light flux passing outside the predetermined numerical aperture is larger than 0.07 λrms on the second information recording plane, and

wherein in case that the first light flux is used, the first light flux passing inside the predetermined numerical aperture and the first light flux passing outside the predetermined numerical aperture are converged on a first information recording plane on a condition that a wave-front aberration is not larger than 0.07 λrms.

133. The optical element of claim 77, wherein the optical pickup apparatus comprises an objective lens,

wherein in case that the first light flux is used, the first light flux positioned inside a predetermined numerical aperture at the image side of the objective lens is converged onto a first information recording plane of a first optical information recording medium on a condition that a wave-front aberration is not larger than 0.07 λrms, wherein the first light flux passing outside the predetermined numerical aperture is converged onto the first information recording plane on a condition that a wave-front aberration is not

larger than 0.07 λrms or shaded so as not to reach to the first information recording plane, and

wherein in case that the second light flux is used, the second light flux passing inside the predetermined numerical aperture and the second light flux passing outside the predetermined numerical aperture are converged onto the second information recording plane of the second optical information recording medium on a condition that a wave-front aberration is not larger than 0.07 λrms, or

wherein in case that the second light flux is used, the second light flux positioned inside a predetermined numerical aperture of the second optical information recording medium at the image side of the objective lens is converged onto the second information recording plane of the second optical information recording medium on a condition that a wave-front aberration is not larger than 0.07 λrms,

wherein the second light flux passing outside the predetermined numerical aperture is converged onto the second information recording plane on a condition that a wave-front aberration is not larger than 0.07 λrms or shaded so as not to reach to the second information recording plane, and

wherein in case that the first light flux is used, the first light flux passing inside the predetermined numerical aperture and the first light flux passing outside the predetermined numerical aperture are converged onto the first information recording plane of the first optical information recording medium on a condition that a wave-front aberration is not larger than 0.07 λrms.

134. The optical pickup apparatus of claim 77, wherein over shoot is 0% to 20%.

135. An apparatus for reproducing information from an optical information recording medium or for recording information onto the optical information recording medium comprising;

an optical pickup apparatus, comprising

a first light source for emitting first light flux having a first wavelength;

a second light source for emitting second light flux having a second wavelength, the first wavelength being different from the second wavelength;

a converging optical system having an optical axis, a diffractive portion, and

a photo detector,

wherein

in case that the first light flux passes through the diffractive portion to generate at least one diffracted ray, an amount of n-th ordered diffracted ray of the first light flux is greater than that of any other ordered diffracted ray of the first light flux, and in case that the second light flux passes through the diffractive portion to generate at least one diffracted ray, an amount of n-th ordered diffracted ray of the second light flux is greater than that of any other ordered diffracted ray of the second light flux, where n stands for an integer other than zero.

136. A method of reproducing information from or recording information on at least two kinds of optical information recording media by an optical pickup apparatus comprising a first light source, a second light source, a photo detector and a converging optical system having an optical axis and a diffractive portion, the method comprising steps of;

emitting first light flux from the first light source or second light flux from the second light flux, wherein a

wavelength of the second light flux is different from a wavelength of the first light flux;

letting the first light or the second light flux pass through the diffractive portion to generate at least one diffracted ray of the first light flux or a least one diffracted ray of the second light flux, wherein when an amount of n-th ordered diffracted ray among the at least one diffracted ray of the first light flux is greater than an amount of any other ordered diffracted ray of the first light flux, an amount of n-th ordered diffracted ray among the at least one diffracted ray of the second light flux is greater than an amount of any other ordered diffracted ray of the second light flux,

converging, by the converging optical system, the n-th ordered diffracted ray of the first light flux onto a first information recording plane of a first optical information recording medium or the n-th ordered diffracted ray of the second light flux onto a second information recording plane of a second optical information recording medium in order for the optical pickup apparatus to record the information onto or reproduce the information from the first information recording plane or the second information recording plane,

detecting, by a photo detector, a first reflected light flux of the converged n-th ordered diffracted light from the first information recording plane or a second reflected light flux of the converged n-th ordered diffracted light from the second information recording plane;

where n stands for an integer other than zero.